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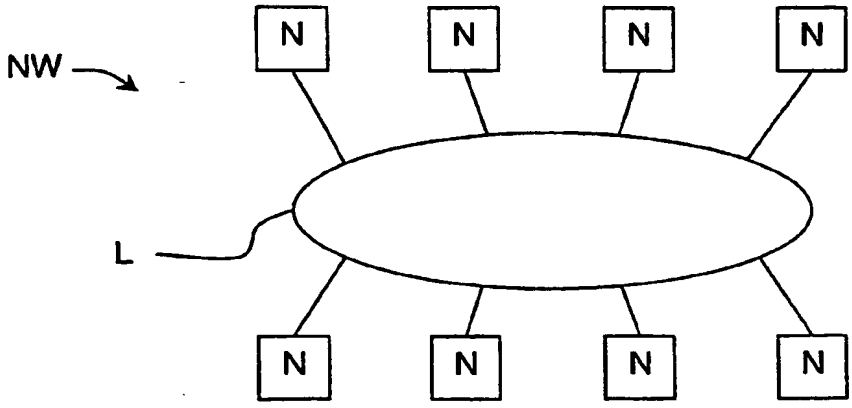
(54) Title: A METHOD FOR CONTROLLING RESOURCES ON A COMMUNICATION LINK THAT TRANSPORTS DATA IN TIME SLOTS



(57) Abstract: A method for handling resources in a digital time-division multiplexed communication network, which network comprises nodes on a link. If a first node is using a time slot when ownership of said time slot is transferred to another node, said first node continues to use said time slot. The actual write access to said time slot is subsequently transferred to the node assigned as the owner of said time slot when said use of said time slot by said first node is complete.

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A METHOD FOR CONTROLLING RESOURCES ON A COMMUNICATION LINK THAT TRANSPORTS DATA IN TIME SLOTS

TECHNICAL FIELD OF THE INVENTION

The present invention relates to a method in connection with controlling utilisation of communication resources in a digital time-division multiplexed communication network. More particularly, the present invention relates to allocation of time slots in a DTM network.

BACKGROUND

An example of a circuit switched time-division multiplexed network is a DTM network (DTM - Dynamic synchronous Transfer Mode). DTM is a broadband network architecture (see e.g. Christer Bohm, Per Lindgren, Lars Ramfelt, and Peter Sjödin, The DTM Gigabit Network, Journal of High Speed Networks, 3(2), 109-126, 1994, and Lars Gauffin, Lars Håkansson, and Björn Pehrson, Multi-gigabit networking based on DTM, Computer Networks and ISDN Systems, 24(2), 119-139, April 1992).

The topology of a DTM network is based on unidirectional communication on time-division multiplexed bitstreams propagating on optical fibres, each bitstream preferably being accessed by multiple nodes, e.g. in a bus or ring structure. The bandwidth of each wavelength is divided into 125 μs frames, which in turn are divided into 64-bit time slots. Write access to such slots is governed by allocation of slots to different nodes. A node may write data into a specific slot, i.e. into a specific time slot position within each frame, only if the node has write access to this specific slot position. The slot access protocol guarantees the slot access to be conflict free, which means that any two or more nodes do not write data into the same slot.

In a system of this kind, write access to the time slots of said frame is typically distributed among the nodes having access to said bitstream. A node will thus

typically own a number of time slots within the frame and may thereby use these time slots for transmission. Also, slot ownership may be changed when required. For example, a node that owns a time slot may, if so requested or required, give away slot ownership of that time slot to a second node that is in need of capacity. The other node will thus be the new owner of the time slot and will, from then on, have the write access to this slot.

In an example of such a system, wherein the feature of time slot ownership is accompanied by a feature of slot borrowing, a first node that owns a time slot may also, if so desired or required, temporarily lend the write access to that time slot to a second node that for some reason requires more transmission capacity. In such a case, the second node borrowing the time slot will temporarily have the write access to the time slot, but will typically be obliged to, at some point in time, return write access to the slot to the owner of the slot, i.e. to the first node.

WO9736402 discloses a method in a communication network of the aforementioned kind, in which the degree of temporary allocation of time slots is evaluated, and in which, responsive to the evaluation of temporary allocation, the number of slots being owned by nodes is changed accordingly. That is, the ownership of a time slot is transferred from one node to another based on the degree of borrowing of time slots.

A general statement of a problem related to the prior art is how to control the long term distribution of write access to time slots without affecting the short term need for control of short term usage and allocation, while always making sure that the write access scheme is conflict free.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a solution to the above problem, and to eliminate other problems in the prior art, by means of a method as set forth in claims 1, 7 and 12.

The prior art ownership transfer approach described above introduces difficulties relating to the situation where a time slot owned by a first node is being used for transmission of data, while the ownership of the time slot is to be transferred to a second node. A prior art outcome in this situation would have involved either a forced tear-down of the communication channel to facilitate the ownership change, which would negatively affect network performance, or a postponing of the ownership change until use of the channel was complete, which would require a more complex control signalling scheme while requiring ownership change actions to be synchronised with respect to time slot usage.

Further difficulties arise in the prior art if a time slot owned by the first node is lent to another node, when the ownership of the time slot is to be transferred to the second node.

Difficulties, such as those discussed above, are eliminated by the new inventive method, for handling resources in a digital time-division multiplexed network, described herein.

In one aspect of the present invention, a node that is receiving ownership of a time slot that is currently in use by another node will regard this new time slot as being lent until the resource (write access to the slot) is no longer in use by said another node, which is typically confirmed by said another node sending a message relating thereto to the first-mentioned node.

In another aspect of the present invention, a node that is presently using a particular time slot, for

transmission of data on a communication channel, will continue to use this slot, regardless of how the ownership of the time slot may change during the use of the time slot. In other words, if a first node uses a time slot and ownership of the time slot is allocated to a second node during the period of time when the first node still uses the slot, the first node may continue to use the slot, typically up to the point in time when the first node stops using the slot. Upon deallocation of the time slot from the channel, the write access to the time slot will be transferred to the proper owner of the time slot, i.e. the second node.

Thus, the invention allows of immediate change of ownership of a time slot without interfering with the short term temporary allocation, i.e. borrowing/lending, of the actual write access to the time slots, through a combination of steps that transfers a time slot from being owned by the first node to instead being temporarily borrowed by the same. The change of status for the time slot, from being owned to being borrowed, can be seen as a direct consequence of the change of ownership. Any ongoing writing of data into the time slot is unaffected. Preferably, when the writing ceases, e.g. when the prior owner of the time slot deallocates the time slot from a channel that it has been used for, the time slot is simply returned to the lender, i.e. the new owner, of the time slot. The time slot could, for example, also be returned after a predefined maximum period of time.

The present invention thus introduces the advantage of a relaxed requirement on the synchronisation of decisions regarding ownership and loan of time slots in the network. Consequently, the decisions regarding ownership and loan, respectively, can be two separate processes handled, if so desired, as more separated features within the design. Hence, the architecture of the system can be

significantly simplified, since ownership and loan procedures may be implemented independent of each other.

Furthermore, the present invention allows of immediate ownership change of time slots, while allocation of the time slots to a channel is maintained. The ownership of a time slot that is being used for transmission of data can thus be changed without affecting (interrupting) the data traffic.

SHORT DESCRIPTION OF THE DRAWINGS

The objects and features of the present invention will be apparent from the following detailed description of a preferred embodiment when read in conjunction with the drawings, in which:

Fig. 1a is a schematic view of an exemplary topology of a time-division multiplexed network,

Fig. 1b illustrates a preferred frame structure, and how the frames are divided into time slots,

Fig. 2 is a schematic signalling diagram showing a loan procedure, and

Fig. 3 is a schematic signalling diagram showing an ownership change procedure.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

An exemplary communication network NW in accordance with the present invention is shown in fig. 1a. In this case, the topology is a single-ring structure comprising one ring link L. All nodes N on the link L can thus communicate by sending messages on the link.

The bandwidth of the link is divided into essentially fixed size, e.g. 125 μs, frames each comprising essentially fixed size, e.g. 64 bit, time slots, as shown in fig. 1b. At a bitrate of 2 Gbps, the number of time slots within each frame is around 3900. For illustrative purposes only a few time slots are shown within each

frame in fig. 1b. The start of each frame is identified by a so-called synchronisation slot S, and the end of each frame is provided with so-called guard band slots G included to accommodate for small jitters in the network frame frequency. The remaining slots of the frame are control and data slots used for transporting control signalling and payload data, respectively, between the nodes N on the link L. Write access to the control and data slots are distributed, and may at any time be re-distributed as desired, among the nodes N connected to the link L.

In a preferred embodiment of the invention, write access to time slots, ownership of time slots, and borrowing of time slots in the exemplified network is handled by control messages sent and received by nodes in the network. These control messages include, but are not limited to, Resource Announce (RES_ANN) messages, Ownership Change Request (CH_REQ) messages, Resource Transfer Request (TR_REQ) messages, Resource Transfer (RES_TR) messages and Ownership Change (OWN_CH) messages.

In this exemplifying embodiment, a Resource Announce (RES_ANN) message can be sent by any node, preferably broadcast to all nodes on the same link, and includes information on the amount of free resources (time slots) being owned by the sending node. This message is intermittently sent by all the nodes on the link to keep the other nodes updated on the demands and/or resource surplus of each node. If one node needs more time slots it can send a Resource Transfer Request (TR_REQ) message to one or more nodes, thereby requesting a loan of time slots. Such message will contain the amount of required resources (number of time slots). If the node receiving the request has a surplus of slots, it can comply with the request, and send a Resource Transfer (RES_TR) message to the requesting node identifying the slots for which write access thereto are being transferred. In this

way, the borrowing and lending of time slots is distributed in the network, and handled by the borrowing and lending nodes.

If any node frequently needs to borrow time slots from other nodes, it can send an Ownership Change Request (CH_REQ) message to a master node, for example being appointed as the node having the lowest link layer address on the link, handling the ownership of time slots in the network, thereby alerting the master of a desired ownership change. This message includes information on the amount of required resources (i.e. number of time slots required). The master node may at any time, for example based on Ownership Change Request messages from nodes, based on auditing the Resource Announce messages, based on network operator input, based on an evaluation of the degree of borrowing and lending of slots, or based on input from another application decide to change the ownership distribution between nodes in the network. A change in ownership distribution of time slots is initiated by an Ownership Change (OWN_CH) message sent by the master node to all the nodes on the link. This message is preferably broadcast, and includes information on which time slots are owned by which nodes. In this way, each node is informed about the ownership of every time slot. If a time slot that was previously owned by a certain node is no longer owned, nor in use, by this node, the time slot is immediately transferred to the new owner by the old owner sending a Resource Transfer (RES_TR) message to the new owner. If, on the other hand, the time slot is being used by the old owner when the Ownership Change (OWN_CH) message transferring the ownership is received, said message indicating that ownership of the slot shall be transferred to another node, the old owner will continue to use the slot, now being a borrowed time slot. As soon as the time slot is free (i.e. no longer in use) it is transferred to the proper owner (of which the using node is aware due to the

Ownership Change (OWN_CH) message) by the borrowing node sending a Resource Transfer message (RES_TR) to the new owner of the time slot.

In this exemplifying embodiment, each time slot is, by each node in the network, considered to be in a certain state. As far as one node is concerned, a time slot can be in one of several states including, but not being limited to, the following states:

FREE, i.e. the time slot is available for immediate use by the node;

BUSY, i.e. the time slot is used for transfer of data by the node, i.e. allocated to a channel (the time slot may be either owned by the node at issue or borrowed from another node);

LENT, i.e. the time slot is owned by the node, but is temporarily allocated (lent) to another node; and

LOST, i.e. the time slot is neither owned by the node at issue, nor borrowed from another node.

The state of a time slot will be affected in the following way, depending on its initial state, responsive to an Ownership Change message.

If the time slot is initially in the FREE state, and the time slot is still owned by the node at issue after receiving the Ownership Change (OWN_CH) message, the time slot remains in the FREE state. If the time slot, on the other hand, is owned by another node after receiving the Ownership Change (OWN_CH) message, the time slot will go into the LOST state, and a Resource Transfer (RES_TR) message will be sent to the new owner.

If the time slot is initially in the LENT state, and the time slot is still owned by the node at issue after receiving the Ownership Change (OWN_CH) message, the time slot remains in the LENT state. If the time slot, on the other hand, is owned by another node after the Ownership

Change (OWN_CH) message, the time slot will go into the LOST state, without any further action.

If the time slot is initially in the LOST state, and the time slot is owned by the node at issue after receiving the Ownership Change (OWN_CH) message, the time slot will go into the LENT state. As soon as the node at issue receives a Resource Transfer (RES_TR) message regarding the particular time slot (from the previous owner), the slot will go into the FREE state. If the time slot, on the other hand, is still owned by another node after reception of the Ownership Change (OWN_CH) message, the time slot will remain in the LOST state.

If the time slot is in the BUSY state when the Ownership Change (OWN_CH) message is received, the time slot will remain in this state regardless of the contents of the Ownership Change (OWN_CH) message. However, upon deallocation of the time slot from a channel, the time slot will go into the FREE state if the slot is still owned by the node at issue. If the slot is no longer owned by the node at issue after the Ownership Change (OWN_CH) message, the deallocation will put the slot in the LOST state, and a Resource Transfer (RES_TR) message will be sent to the new owner.

An ownership change procedure will now be described in more detail, with reference to figure 2. For illustrative purposes, a link is considered to comprise three nodes: A, B and C. In this example, node C is a master node handling the distribution of time slot ownership between the nodes. All the nodes on the link intermittently broadcast Resource Announce (RES_ANN) messages 10 to all nodes on the link, these messages containing information on the number of slots in the FREE state at the respective sender of the message, and optionally information about a safe margin buffer or the number of slots being borrowed from other nodes. It is now assumed that node B comes to the conclusion that it would be

beneficial if it could own more slots. Node B then sends an Ownership Change Request message (CH_REQ) 11 to node C (the master node), requesting ownership of a greater number of slots. It is not required by the master node to receive an Ownership Change Request for making a decision about ownership redistribution, but it is taken as an alert about a desire for redistribution of slot ownership. Based on an audit of the Resource Announce messages 10, and optionally on received Ownership Change Request messages 11, it is assumed that the master node C decides to change the ownership of time slots, where node B is to take over the ownership of certain slots from node A. Consequently, master node C broadcasts an Ownership Change (OWN_CH) message 12 containing the new ownership distribution to all nodes on the link. Responsive to the Ownership Change message 12, node B will conclude that a greater number of slots are now to be owned by node B, while node A will conclude that a smaller number of slots are now to be owned by node A. All new time slots allocated to node B will be put in the LENT state by node B until write access to these slots is transferred to (and received by) node B. Any time slots that are in the FREE state at node A, and for which node B is to be the new owner, are then more or less immediately transferred to node B (through a RES_TR message 13a), thereby entering the LOST state at node A and entering the FREE state at node B. Slots used by (i.e. being in the BUSY state of) node A, and for which node B is to be the new owner, remains in the BUSY state at node A as long as the channel to which these slots are allocated is being used for transmission of data. As soon as the slots are deallocated from the channel, they are transferred to node B (the new owner) through another RES_TR message 13b, node A then putting the slot in the LOST state, and node B putting the slot in the FREE state. In this way, an ownership change of time slots from node A to node B is ordered by the master node

without the master node interfering with or having to consider the channels to which some of the slots are allocated.

In the exemplifying embodiment described above, allocation of time slots, or resource control, is mainly accomplished by signalling between nodes on the link. However, distribution of resources could equally well be signalled from, decided upon by and originate from a network operator, as well as various other conceivable applications.

With reference to fig. 3, a loan procedure will now be described in further detail. For illustrative purposes, a link is considered to comprise three nodes: A, B and C. As in the previous example, node C is assumed to be a master node controlling the ownership of time slots. However, the master node is not as such involved in the loan procedure.

As illustrated, node A announces its resources by broadcasting a Resource Announce message (RES_ANN) 20 to all other nodes (including the master node). In the exemplified situation, node B requires write access to a greater number of time slots for transmission of data. By the Resource Announce (RES_ANN) message 20 sent by node A, node B receives the assumed information that node A keeps a surplus of time slots. To initiate the loan procedure, node B sends a Transfer Request (TR_REQ) message 21 to node A, requesting a transfer of time slots to node B (i.e. requesting a transfer of write access to time slots). Node A replies to the request (complies with the request) by sending a Resource Transfer (RES_TR) message 22, containing an identification of the transferred time slots, to node B, node B thereby gaining write access to, i.e. borrowing, the identified time slots. Node B then starts to transmit data using the transferred time slots. When the data transmission is complete, node B returns some, or all, of the borrowed

time slots to node A by sending a Resource Transfer (RES_TR) message 23 to node A, containing an identification of the returned time slots. In this example, the ownership of the borrowed time slots did not change during the loan procedure. However, if the time slots borrowed by node B have a new owner when they are to be returned, they are returned to the proper (new) owner. In this way, a versatile short term allocation (loan) of time slots is accomplished without causing long term fragmentation. Note that the master node C is completely outside the loan procedure. The master node C may, however, audit the loan procedure by listening to the messages sent by the borrowing and lending nodes. Moreover, the master node C itself may, of course, participate in a loan procedure as any other node on the link, whereby the master not does not act as a master node, but rather as a normal borrowing/lending node, in accordance with the inventive loan procedure not requiring any controlling master node.

Consequently, loan of time slots between nodes is taking place in the system without interference from the master node, and ownership change is controlled by the master node without essentially interfering with any ongoing loan between nodes or actual use of slots on the link.

In the described embodiment of the invention, loan is considered to take place between the node owning the time slot and the node borrowing the time slot. Nevertheless, other loan procedures are possible within the scope of the invention. For example, the borrowing node can lend the slot further to another node which may lend the slot to yet another node, whereby "borrowing chains" are produced. The time slot can then be returned, i.e. the write access can be transferred to, the proper owner stepwise (along the "borrowing chain") or directly.

To be noted, although time slot ownership and/or borrowing/lending has been described herein primarily

with respect to time slot positions as such within a recurrent frame, such access could also advantageously be negotiated with respect to only a portion of the concerned link, thereby making it possible for different nodes to have access/control of the same time slot over different portions of the link, sometimes referred to as "slot reuse".

The above disclosure of a preferred embodiment is not intended to limit the scope of the invention, but should merely be taken as a preferred mode of carrying out the invention. The scope of the invention is defined in the appended claims.

CLAIMS

1. A method for handling resources in a digital time-division multiplexed communication network, said network comprising nodes on a link, wherein a first node, if using a time slot when ownership of said time slot is transferred to another node, continues to use said time slot, actual write access to said time slot subsequently being transferred to the node assigned as the owner of said time slot when said use of said time slot by said first node is complete.

2. A method according to claim 1, wherein said time slot is a time slot position in a recurring frame on said link.

3. A method according to claim 1 or 2, wherein said time slot is considered to be used by said first node if said first node accesses said time slot for transmission of data.

4. A method according to claim 1, 2 or 3, wherein said time slot is considered to be in use by said first node if said time slot is allocated to a channel by said first node.

5. A method according to any one of the preceding claims, further comprising the steps of:

receiving, in said first node, a message imperative of an ownership change of time slots, resulting in said first node losing ownership of time slots;

immediately transferring write access to any concerned time slots, not currently used by said first node, from said first node to the node that is assigned as the new owner of said time slots; and

successively transferring write access to any concerned time slots, from said first node to the node that is assigned as the new owner of said time slots, as soon as said concerned time slots are no longer in use by said first node.

6. A method according to claim 5, wherein ownership of time slots is transferred between nodes by a broadcast message imperative of a time slot ownership change, which message is broadcast from a master node controlling ownership distribution.

7. A method for handling resources in a digital time-division multiplexed communication network, said network comprising nodes on a link, wherein a node, when assigned to take over the ownership of a time slot, refrains from using said time slot for transmitting data until write access to the time slot is transferred to said node from another node, thereby allowing said another node to continue to use said time slot until its use thereof is complete.

8. A method according to claim 7, wherein said a node, when assigned to take over the ownership of said time slot, regards said time slot as being lent until write access to said time slot is transferred to said node from another node.

9. A method according to claim 7 or 8, wherein said time slot is a time slot position in a recurring frame on said link.

10. A method according to claim 9, wherein said time slot is a time slot on a shared link, thereby allowing a transfer of time slot resources between nodes connected to the same shared link.

11. A method according to claim 7, 8, 9 or 10, further comprising the steps of:

receiving, in said a node, a message imperative of an ownership change of time slots, resulting in said node gaining ownership of time slots;

regarding any concerned time slots as being lent by said node, write access to said concerned time slots thus being allocated to some other node; and

receiving, in said node, a message giving said node

write access to one or more of said concerned time slots, the node thereby being free to use said one or more of said concerned time slots.

12. A method for handling resources in a digital time-division multiplexed communication network, said network comprising nodes on a link, where the nodes are capable of having ownership of time slots and capable of borrowing and lending time slots, wherein, if a first node is using a time slot for transmission of data on a channel when ownership of said time slot is transferred to another node assigned as a new owner, said first node continues to use said time slot, the time slot being regarded as lent by the node assigned as a new owner, and being regarded as borrowed by said first node currently using said time slot from the node being assigned as the owner of said time slot.

13. A method according to claim 12, wherein said time slot is a time slot position in a recurring frame on said link.

14. A method according to claim 12 or 13, wherein said time slot is no longer to be considered borrowed by said first node when said first node's use of said time slot is complete.

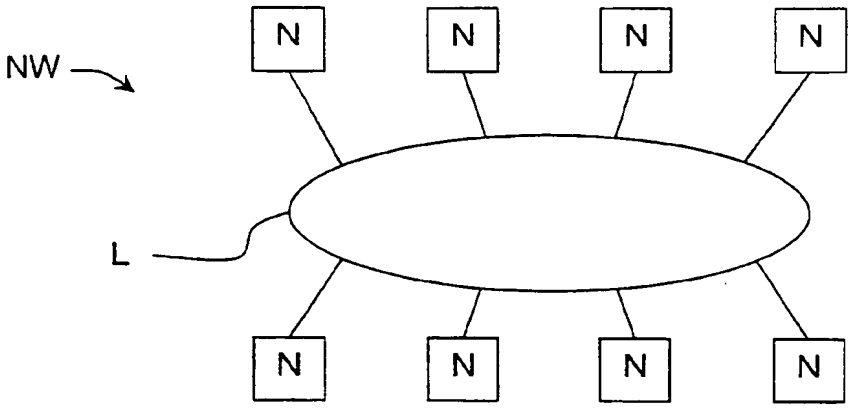
NW
N
N
N
N
L
N
N
N
N

FIG. 1a

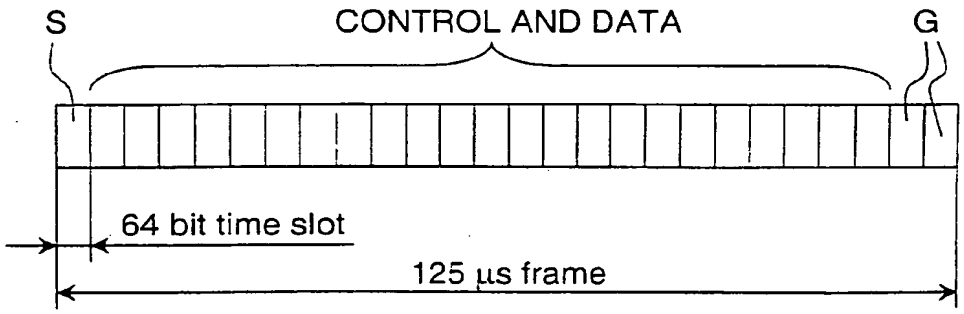
S
CONTROL AND DATA
G
64 bit time slot
125 µs frame

FIG. 1b

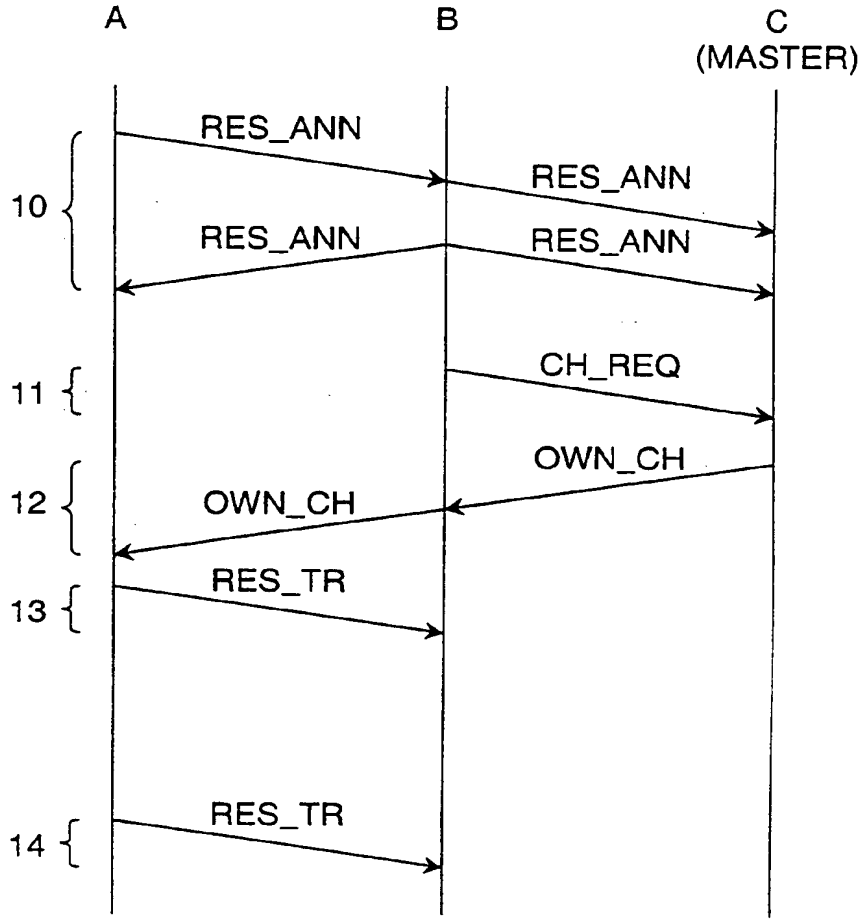
A
B
C
(MASTER)
RES_ANN
RES_ANN
10
RES_ANN
RES_ANN
CH_REQ
11
OWN_CH
12
OWN_CH
RES_TR
13
RES_TR
14

FIG. 2

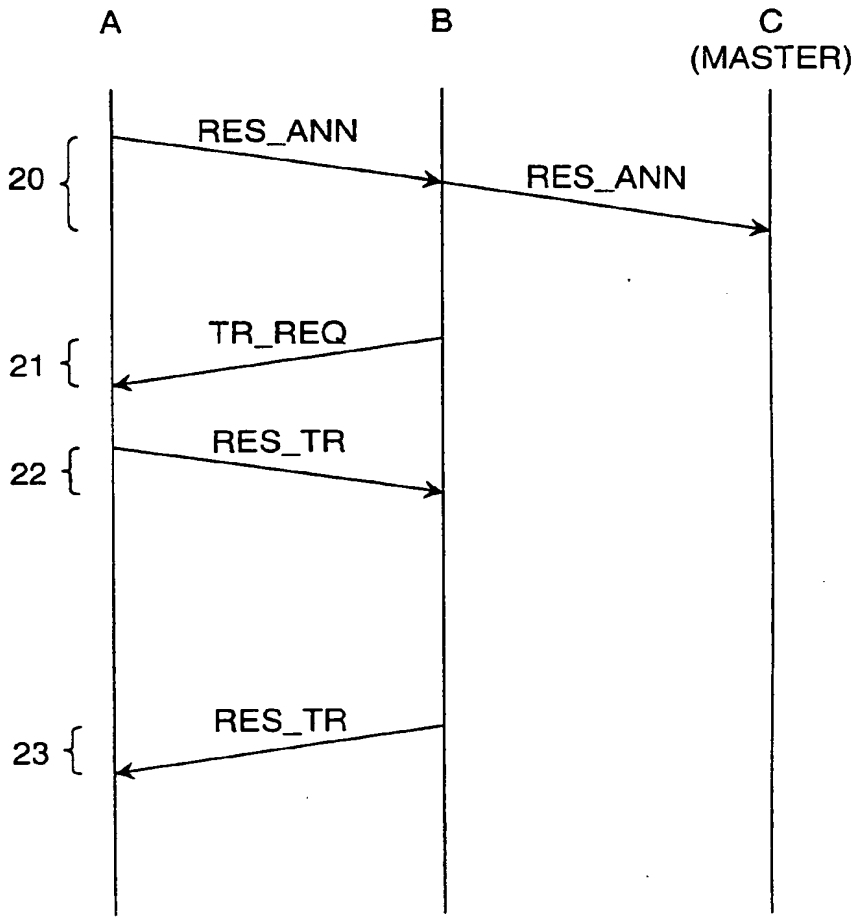

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 00/02106

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04L 12/52, H04Q 11/06, H04J 3/16
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04L, H04Q, H04J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9736402 A1 (NET INSIGHT AB), 2 October 1997 (02.10.97), page 15, line 4 - page 19, line 3; page 20, line 22 - page 21, line 6, claims 25-27 --	1-14
A	WO 9955036 A2 (NET INSIGHT AB), 28 October 1999 (28.10.99), page 6, line 30 - page 9, line 16; page 15, line 24 - page 16, line 26, claims 1,9, 20 --	1-14
A	WO 9724846 A1 (DYNARC AB), 10 July 1997 (10.07.97), page 44, line 15 - line 19, claims 1,5,20 --	1-14

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
27 March 2001	30 -03- 2001
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Roger Bou Faisal/LR Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4866708 A (M.ARDON ET AL), 12 Sept 1989 (12.09.89), column 1, line 55 - column 2, line 38; column 5, line 63 - column 6, line 54; column 8, line 59 - column 9, line 37, figure 4 --	1-14
A	EP 0428407 A2 (DIGITAL EQUIPMENT CORPORATION), 22 May 1991 (22.05.91), page 5, line 6 - line 16 --	1-14
A	EP 0510290 A1 (INTERNATIONAL BUSINESS MACHINES CORPORATION), 28 October 1992 (28.10.92), column 2, line 31 - column 3, line 7; column 6, line 53 - column 7, line 46 --	1-14
A	Patent Abstracts of Japan, abstract of JP 4-316240 A (FUJI XEROX CO LTD), 6 November 1992 (06.11.92) -- --------	1-14

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/SE 00/02106

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9736402 A1	02/10/97	AU 2314797 A	17/10/97
		EP 0850429 A	01/07/98
		EP 0886934 A	30/12/98
		SE 9601130 D	00/00/00
		US 6122425 A	19/09/00
WO 9955036 A2	28/10/99	AU 4177599 A	08/11/99
		AU 8365398 A	10/02/99
		BR 9810762 A	15/08/00
		EP 0998713 A	10/05/00
		EP 1072117 A	31/01/01
		SE 513221 C	31/07/00
		SE 9801335 A	18/10/99
WO 9724846 A1	10/07/97	AU 1404197 A	28/07/97
		CA 2241554 A	10/07/97
		EP 0873629 A	28/10/98
		JP 2000502856 T	07/03/00
		SE 9504681 A	04/08/97
		US 5982780 A	09/11/99
US 4866708 A	12/09/89	CA 1331398 A	09/08/94
		DE 3886547 D,T	23/06/94
		EP 0385982 A,B	12/09/90
		JP 2746398 B	06/05/98
		JP 3500949 T	28/02/91
		KR 9607584 B	05/06/96
		WO 8904104 A	05/05/89
EP 0428407 A2	22/05/91	AU 627953 B	03/09/92
		AU 6652490 A	23/05/91
		CA 2029850 A	16/05/91
		JP 3173235 A	26/07/91
		US 5313467 A	17/05/94
EP 0510290 A1	28/10/92	CA 2060981 C	08/08/95
		DE 69124596 D,T	21/08/97
		JP 2103144 C	22/10/96
		JP 6029992 A	04/02/94
		JP 8017389 B	21/02/96
		US 5327428 A	05/07/94